

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference P/61209/DSD	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 98/ 02586	International filing date (day/month/year) 27/08/1998	(Earliest) Priority Date (day/month/year) 15/10/1997
Applicant GEC MARCONI AVIONICS (HOLDINGS) LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable (see Box I).

2. ☐ Unity of invention is lacking (see Box II).

3. ☐ The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing

☐ filed with the international application.

☐ furnished by the applicant separately from the international application.

☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

☐ Transcribed by this Authority

4. With regard to the title, ☒ the text is approved as submitted by the applicant

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is:

Figure No. 2 ☒ as suggested by the applicant.

☐ None of the figures.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 98/02586

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 6 G02F1/1333 C03B33/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	US 5 808 719 A (SHARP) 15 September 1998	1-7, 9, 17, 19-21, 24-26
X	see column 5, line 37 - column 13, line 12; figures 13, 20 -& JP 08 076074 A (SHARP) 22 March 1996	1-7, 9, 17, 19-21, 24-26
X	see figures 13, 20 --- PATENT ABSTRACTS OF JAPAN vol. 96, no. 10 & JP 08 146444 A (NIPPONDENSO), 7 June 1996 see figures A-D --- -/--	1, 14

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
 "E" earlier document but published on or after the international filing date
 "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
 "O" document referring to an oral disclosure, use, exhibition or other means
 "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"S" document member of the same patent family

Date of the actual completion of the international search

24 November 1998

Date of mailing of the international search report

03/12/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

Authorized officer

Diot, P

INTERNATIONAL SEARCH REPORT

International Application No

CT/GB 98/02586

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 245 (P-881) & JP 01 048024 A (SEIKO), 22 February 1989 see abstract ---	5
X	JP 08 122769 A (SHARP) 17 May 1996 see figure 3B	1,20
E	-& US 5 812 226 A (SHARP) 22 September 1998 see figures 1,20 ---	1,20
A	WO 93 11452 A (MAGNASCREEN) 10 June 1993 see page 5, line 09 - line 30 ---	1,20
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 194 (P-1722), 5 April 1994 & JP 06 003633 A (FUJITSU LTD), 14 January 1994 see abstract ---	29
A	PATENT ABSTRACTS OF JAPAN vol. 008, no. 093 (C-220), 27 April 1984 & JP 59 008632 A (MITSUBOSHI DIAMOND KOGYO KK), 17 January 1984 see abstract -----	29-32

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 98/02586

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5808719	A	15-09-1998	JP 8076074 A	22-03-1996
JP 8122769	A	17-05-1900	CN 1120178 A	10-04-1996
			US 5812226 A	22-09-1998
WO 9311452	A	10-06-1993	US 5353133 A	04-10-1994

PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF RECEIPT OF
RECORD COPY

(PCT Rule 24.2(a))

To:

HOSTE, Colin, Francis
GEC Patent Dept.
Waterhouse Lane
Chelmsford
Essex CM1 2QX
ROYAUME-UNI

KL	KL
AF	16.10.98
25 SEP 1998	

Date of mailing (day/month/year) 16 September 1998 (16.09.98)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference P/61209/DSD	International application No. PCT/GB98/02586

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

GEC MARCONI AVIONICS (HOLDINGS) LIMITED (for all designated States except US)

WATSON, David, Stewart, Nimmo (for US)

International filing date : 27 August 1998 (27.08.98)
 Priority date(s) claimed : 15 October 1997 (15.10.97)
 07 July 1998 (07.07.98)
 Date of receipt of the record copy
 by the International Bureau : 14 September 1998 (14.09.98)
 List of designated Offices :

AP : GH,GM,KE,LS,MW,SD,SZ,UG,ZW
 EA : AM,AZ,BY,KG,KZ,MD,RU,TJ,TM
 EP : AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
 OA : BF,BJ,CF,CG,CI,CM,GA,GN,GW,ML,MR,NE,SN,TD,TG
 National : AL,AM,AT,AU,AZ,BA,BB,BG,BR,BY,CA,CH,CN,CU,CZ,DE,DK,EE,ES,FI,GB,GE,GH,GM,
 HR,HU,ID,IL,IS,JP,KE,KG,KP,KR,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,PL,
 PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,US,UZ,VN,YU,ZW

ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- ☒ time limits for entry into the national phase
☐ confirmation of precautionary designations
☐ requirements regarding priority documents

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer:

Mougamadou Abidine

Telephone No. (41-22) 338.83.38

INFORMATION ON TIME LIMITS FOR ENTERING THE NATIONAL PHASE

The applicant is reminded that the "national phase" must be entered before each of the designated Offices indicated in the Notification of Receipt of Record Copy (Form PCT/IB/301) by paying national fees and furnishing translations, as prescribed by the applicable national laws.

The time limit for performing these procedural acts is **20 MONTHS** from the priority date or, for those designated States which the applicant elects in a demand for international preliminary examination or in a later election, **30 MONTHS** from the priority date, provided that the election is made before the expiration of 19 months from the priority date. Some designated (or elected) Offices have fixed time limits which expire even later than 20 or 30 months from the priority date. In other Offices an extension of time or grace period, in some cases upon payment of an additional fee, is available.

In addition to these procedural acts, the applicant may also have to comply with other special requirements applicable in certain Offices. **It is the applicant's responsibility** to ensure that the necessary steps to enter the national phase are taken in a timely fashion. Most designated Offices do not issue reminders to applicants in connection with the entry into the national phase.

For detailed information about the procedural acts to be performed to enter the national phase before each designated Office, the applicable time limits and possible extensions of time or grace periods, and any other requirements, see the relevant Chapters of Volume II of the PCT Applicant's Guide. Information about the requirements for filing a demand for international preliminary examination is set out in Chapter IX of Volume I of the PCT Applicant's Guide.

GR and ES became bound by PCT Chapter II on 7 September 1996 and 6 September 1997, respectively, and may, therefore, be elected in a demand or a later election filed on or after 7 September 1996 and 6 September 1997, respectively, regardless of the filing date of the international application. (See second paragraph above.)

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

CONFIRMATION OF PRECAUTIONARY DESIGNATIONS

This notification lists only specific designations made under Rule 4.9(a) in the request. It is important to check that these designations are correct. Errors in designations can be corrected where precautionary designations have been made under Rule 4.9(b). The applicant is hereby reminded that any precautionary designations may be confirmed according to Rule 4.9(c) before the expiration of 15 months from the priority date. If it is not confirmed, it will automatically be regarded as withdrawn by the applicant. There will be no reminder and no invitation. Confirmation of a designation consists of the filing of a notice specifying the designated State concerned (with an indication of the kind of protection or treatment desired) and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.

REQUIREMENTS REGARDING PRIORITY DOCUMENTS

For applicants who have not yet complied with the requirements regarding priority documents, the following is recalled.

Where the priority of an earlier national, regional or international application is claimed, the applicant must submit a copy of the said earlier application, certified by the authority with which it was filed ("the priority document") to the receiving Office (which will transmit it to the International Bureau) or directly to the International Bureau, before the expiration of 16 months from the priority date, provided that any such priority document may still be submitted to the International Bureau before that date of international publication of the international application, in which case that document will be considered to have been received by the International Bureau on the last day of the 16-month time limit (Rule 17.1(a)).

Where the priority document is issued by the receiving Office, the applicant may, instead of submitting the priority document, request the receiving Office to prepare and transmit the priority document to the International Bureau. Such request must be made before the expiration of the 16-month time limit and may be subjected by the receiving Office to the payment of a fee (Rule 17.1(b)).

If the priority document concerned is not submitted to the International Bureau or if the request to the receiving Office to prepare and transmit the priority document has not been made (and the corresponding fee, if any, paid) within the applicable time limit indicated under the preceding paragraphs, any designated State may disregard the priority claim, provided that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity to furnish the priority document within a time limit which is reasonable under the circumstances.

Where several priorities are claimed, the priority date to be considered for the purposes of computing the 16-month time limit is the filing date of the earliest application whose priority is claimed.

PATENT COOPERATION TREATY

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From the INTERNATIONAL BUREAU

NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

HOSTE, Colin, Francis
GEC Patent Dept.
Waterhouse Lane
Chelmsford
Essex CM1 2QX
ROYAUME-UNI

Date of mailing (day/month/year) 16 September 1998 (16.09.98)	
Applicant's or agent's file reference P/61209/DSD	IMPORTANT NOTIFICATION
International application No. PCT/GB98/02586	International filing date (day/month/year) 27 August 1998 (27.08.98)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 15 October 1997 (15.10.97)
Applicant GEC MARCONI AVIONICS (HOLDINGS) LIMITED et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column; by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
3. An **asterisk(*)** appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
4. The **letters "NR"** appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
15 Octo 1997 (15.10.97)	9721804.4	GB	14 Sept 1998 (14.09.98)
07 July 1998 (07.07.98)	9814577.4	GB	14 Sept 1998 (14.09.98)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer


Mougamadou Abidine

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

HOSTE, Colin, Francis
GEC Patent Dept.
Waterhouse Lane
Chelmsford
Essex CM1 2QX
ROYAUME-UNI

KM	KM
For	PC
APR 1999	

Date of mailing (day/month/year) 22 April 1999 (22.04.99)		
Applicant's or agent's file reference P/61209/DSD		IMPORTANT NOTICE
International application No. PCT/GB98/02586	International filing date (day/month/year) 27 August 1998 (27.08.98)	
		Priority date (day/month/year) 15 October 1997 (15.10.97)
Applicant GEC MARCONI AVIONICS (HOLDINGS) LIMITED et al		

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:

AU,BR,CN,EP,IL,JP,KP,KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AL,AM,AP,AT,AZ,BA,BB,BG,BY,CA,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GE,GH,GM,HR,HU,ID,IS,
KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,
SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 22 April 1999 (22.04.99) under No. WO 99/19765

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer J. Zahra Telephone No. (41-22) 338.83.38
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PATENT COOPERATION TREATY

PCT

INFORMATION CONCERNING ELECTED
OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

From the INTERNATIONAL BUREAU

To:

HOSTE, Colin, Francis
GEC Patent Dept.
Waterhouse Lane
Chelmsford
Essex CM1 2QX
ROYAUME-UNI

RM	HM
foreg	pc
4 JUN 1999	
AE	15/10/98

Date of mailing (day/month/year) 10 June 1999 (10.06.99)		
Applicant's or agent's file reference P/61209/DSD		IMPORTANT INFORMATION
International application No. PCT/GB98/02586	International filing date (day/month/year) 27 August 1998 (27.08.98)	
		Priority date (day/month/year) 15 October 1997 (15.10.97)
Applicant GEC MARCONI AVIONICS (HOLDINGS) LIMITED et al		

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

AP : GH, GM, KE, LS, MW, SD, SZ, UG, ZW

EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE

National : AU, BG, BR, CA, CN, CZ, DE, GB, IL, JP, KP, KR, MN, NO, NZ, PL, RO, RU, SE, SK, US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM

OA : BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG

National : AL, AM, AT, AZ, BA, BB, BY, CH, CU, DK, EE, ES, FI, GE, GH, GM, HR, HU, ID, IS, KE,
KG, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MW, MX, PT, SD, SG, SI, SL, TJ, TM, TR, TT, UA,
UG, UZ, VN, YU, ZW

3. The applicant is reminded that he must enter the "national phase" **before the expiration of 30 months from the priority date** before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

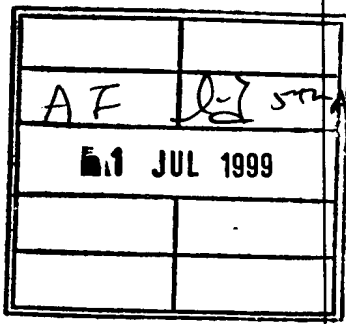
The entry into the European regional phase is postponed **until 31 months from the priority date** for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer S. Mafla
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

From the:
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:
HOSTE, C.
GEC Patent Department
Waterhouse Lane
Chelmsford
Essex CM1 2QX
GRANDE BRETAGNE



PCT

WRITTEN OPINION

(PCT Rule 66)

Date of mailing
(day/month/year)

22. 06. 1999

Applicant's or agent's file reference

P/61209/DSD

REPLY DUE

within 3 month(s)
from the above date of mailing

International application No.

PCT/GB98/02586

International filing date (day/month/year)

27/08/1998

Priority date (day/month/year)

15/10/1997

International Patent Classification (IPC) or both national classification and IPC

G02F1/1333

Applicant

GEC MARCONI AVIONICS (HOLDINGS) LIMITED et al.

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain document cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

3. The applicant is hereby **invited to reply** to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4.
For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis.
For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 15/02/2000.

Name and mailing address of the international preliminary examining authority:



European Patent Office - P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk - Pays Bas
Tel. (+31-70) 340-2040 Tx: 31 651 epo nl
Fax: (+31-70) 340-3016

Authorized officer / Examiner

Diot, P

Formalities officer (incl. extension of time limits)
Kruidenberg, G
Telephone No. (+31-70)-340 2277



WRITTEN OPINION

International application No. PCT/GB98/02586

I. Basis of the opinion

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed".*):

Description, pages:

1-18 as originally filed

Claims, No.:

1-32 as originally filed

Drawings, sheets:

1/5-5/5 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1,14,19,20
Inventive step (IS)	Claims	1-7, 9,12-17,19-26
Industrial applicability (IA)	Claims	1-32

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1: JP A 8146444

D2: JP A 6003633

D3: JP A 8122769

I. A. Document D1, which is regarded as being the closest prior art to the subject-matter of claim 1*, shows (the references in parentheses applying to this document):

a method of manufacturing a liquid crystal display sealed between first and second (4) transparent plates which form an operative area of the display, comprising removing an excess region (2) of a pre-manufactured liquid crystal display by cutting the first and second plates to isolate the excess region and to expose cut edges along the operative areas of the first and second plates.

* It is noted that the method of claim 1 comprises only one step: cutting the first and second plates of a liquid crystal display. Such a banal feature can not be considered as a technical feature of the invention as specified in Rule 6.3 (a) PCT.

The subject-matter of claim 1 is therefore not novel (Article 33(2) PCT).

The same applied mutatis mutandis for claims 19 and 20.

The step of applying pressure to at least one plate is mentioned in D1, therefore, claim 14 is also not novel.

B. Dependent claims 2-7, 9, 12, 13, 15-17, 21-26 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, the reasons being as follows:

B1. Dependent claims 2-7, 9, 21 refer to known methods of cutting glass plate of a liquid crystal display (see D2).

B2. Dependent claims 15, 16, 22, 23 refer to known method of sealing a liquid crystal device. It would be obvious for the skilled person in the art, namely when the same result is to be achieved, to apply these features to a device according to D1, thereby arriving at a method (and device) according to claims 15, 16, 22, 23.

B3. Dependent claims 17, 24-26 refer to a known method of manufacturing large screen LCD where single Lcds are joined on a side (see D3, figure 3b).

B4. Dependent claims 12 and 13 refer to steps considered as straightforward to the skilled person.

II. The combination of the features of dependent claim 8 is neither known from, nor rendered obvious by, the available prior art. It is suggested therefore that a new independent claim be drafted to include these features.

Re Item VII

Certain defects in the international application

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

Claims 18, 27, 28, 32 contain references to drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

The features of the claim 29 are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Certain observations on the international application

As explained below, some of the features in the apparatus claims 20 and 22 relate to a

**WRITTEN OPINION
SEPARATE SHEET**

International application No. PCT/GB98/02586

method of manufacturing the display rather than clearly defining the display in terms of its technical features. The intended limitations are therefore not clear from these claims, contrary to the requirements of Article 6 PCT.

The excess region which is removed is not part of the display device.

The fact that the plates are melt together by a laser beam is not a feature of the display.

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P/61209/DSD		FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB98/02586	International filing date (day/month/year) 27/08/1998	Priority date (day/month/year) 15/10/1997	
International Patent Classification (IPC) or national classification and IPC G02F1/1333			
Applicant GEC MARCONI AVIONICS (HOLDINGS) LIMITED et al.			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 6 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 11/05/1999	Date of completion of this report 17. 01. 00
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer Diot, P Telephone No. +31 70 340 3282 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB98/02586

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

2-18 as originally filed

1,1a as received on 18/09/1999 with letter of 16/09/1999

Claims, No.:

1-32 as originally filed

Drawings, sheets:

1/5-5/5 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB98/02586

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	2-13,15-18, 21-32
	No:	Claims	1,14,19,20
Inventive step (IS)	Yes:	Claims	8,10-13,29-32
	No:	Claims	1-7,9,14-28
Industrial applicability (IA)	Yes:	Claims	1-32
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB98/02586

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
Reference is made to the following documents:

D1: JP A 8146444
D2: JP A 6003633
D3: JP A 8122769
D4: JP A 59008632

I. A. Document D1, which is regarded as being the closest prior art to the subject-matter of claim 1*, shows (the references in parentheses applying to this document):

a method of manufacturing a liquid crystal display sealed between first and second (4) transparent plates which form an operative area of the display, comprising removing an excess region (2) of a pre-manufactured liquid crystal display by cutting the first and second plates to isolate the excess region and to expose cut edges along the operative areas of the first and second plates.

* It is noted that the method of claim 1 comprises only one step: cutting the first and second plates of a liquid crystal display. Such a banal feature can not be considered as a technical feature of the invention as specified in Rule 6.3 (a) PCT.

The subject-matter of claim 1 is therefore not novel (Article 33(2) PCT).

The same applied mutatis mutandis for claims 19 and 20.

The step of applying pressure to at least one plate is mentioned in D1, therefore,

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB98/02586

claim 14 is also not novel.

B. Dependent claims 2-7, 9, 15-26 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, the reasons being as follows:

B1. Dependent claims 2-7, 9, 21 refer to known methods of cutting glass plate of a liquid crystal display (see D2).

B2. Dependent claims 15, 16, 22, 23 refer to known method of sealing a liquid crystal device. It would be obvious for the skilled person in the art, namely when the same result is to be achieved, to apply these features to a device according to D1, thereby arriving at a method (and device) according to claims 15, 16, 22, 23.

B3. Dependent claims 17, 24-26 refer to a known method of manufacturing large screen LCD where single LCDs are joined on a side (see D3, figure 3b).

II. The Apparatus subject-matter of claims 29-32 relates to a fracturing platform having first and second polarizers;
a raised region and a liquid crystal display in which a groove has been formed in one of his plates.

This apparatus allows an operator, when applying a pressure to a region of the LCD, to observe a light area along the groove against the dark area background of the liquid crystal display therefore allowing the operator to easily find the fracture line.

Such a device is new and inventive over the prior art represented by Document D4.

Therefore, claims 29-32 meet the criteria set out in PCT Article 33(2)-(4).

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB98/02586

Dependent claim 8 which contains reference to the device of claim 29 meet the criteria set out in PCT Article 33(2)-(4) for the same reasons.

Re Item VII

Certain defects in the international application

Claims 18, 27, 28, 32 contain references to drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

The features of the claim 29 are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Certain observations on the international application

As explained below, some of the features in the apparatus claims 20 and 23 relate to a method of manufacturing the display rather than clearly defining the display in terms of its technical features. The intended limitations are therefore not clear from these claims, contrary to the requirements of Article 6 PCT. Claim 20; the excess region which is removed is not part of the display device. Claim 23; the fact that a laser beam is used to melt the plates together is not a feature of the display.

18. Sep. 1999

IMPROVEMENTS IN OR RELATING TO LIQUID CRYSTAL DISPLAYS

This invention relates to a liquid crystal display, to a method of manufacturing a liquid crystal display, and also to apparatus to aid manufacture of a liquid crystal display.

5 Generally, displays for reproduction of information have historically been of a cathode ray tube type construction. In an environment where space is limited traditional displays were typically manufactured to be square, or square with rounded corners, in order to make the best use of the limited space available.

10 Liquid crystal displays are currently considered suitable substitutes for applications previously requiring cathode ray tube technology. The replacement of cathode ray tubes can be either for new applications or for the purpose of upgrading existing technology through retrofit design. When manufactured in large quantities, liquid crystal displays are of modest cost compared with an equivalent cathode ray tube.

15 JP A 8146444 illustrates a typical method of manufacturing a prior art liquid crystal display. A display panel, which has been swollen by liquid crystal therein, is divided into two parts. The first part is arranged to receive liquid crystal and the second part is arranged to provide an overspill compartment, such that when the panel is pressed and heated, the liquid crystal causing the panel to swell is allowed to enter the second part. The boarder between the first
20 and attached second part is removed to leave only the first part to form a liquid crystal display panel. This method of manufacturing can be used when producing panels in large quantities.

However, when liquid crystal displays need to be custom made in relatively low numbers to suit specific requirements, the cost per unit is very high due to expensive tooling and manufacturing charges. Furthermore, manufacturing yield rates are low, high pixel defect levels have to be tolerated and there are substantial delivery delays.

5

It is an objective of the present invention to facilitate the production of custom made liquid crystal displays.

-1-

IMPROVEMENTS IN OR RELATING TO LIQUID CRYSTAL DISPLAYS

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20 It is an objective of the present invention to facilitate the production of custom made liquid crystal displays.

PATENT COOPERATION TREATY

From the
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NOTIFICATION OF TRANSMITTAL OF
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Applicant's or agent's file reference
P/61209/DSD

IMPORTANT NOTIFICATION

International application No.
PCT/GB98/02586

International filing date (day/month/year)
27/08/1998

Priority date (day/month/year)
15/10/1997

Applicant
GEC MARCONI AVIONICS (HOLDINGS) LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

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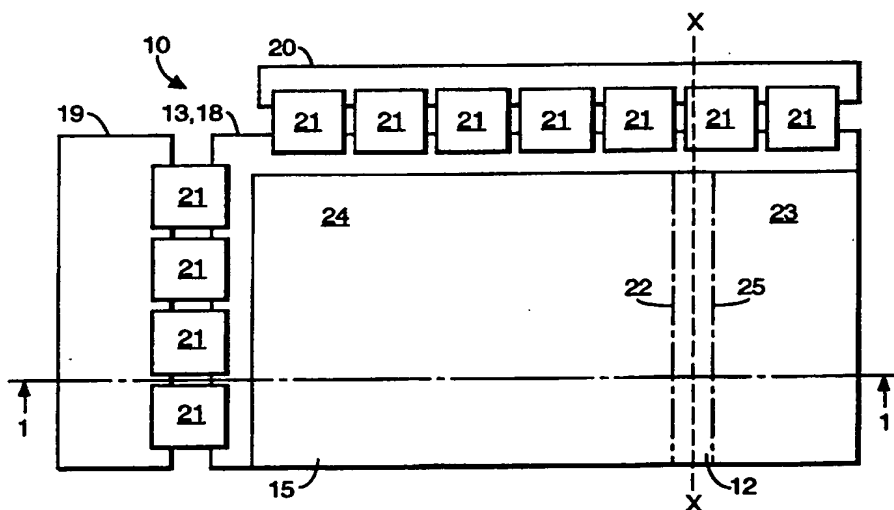




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G02F 1/1333, C03B 33/02		A1	(11) International Publication Number: WO 99/19765
			(43) International Publication Date: 22 April 1999 (22.04.99)
(21) International Application Number: PCT/GB98/02586		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 27 August 1998 (27.08.98)			
(30) Priority Data: 9721804.4 15 October 1997 (15.10.97) GB 9814577.4 7 July 1998 (07.07.98) GB			
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(54) Title: IMPROVEMENTS IN OR RELATING TO LIQUID CRYSTAL DISPLAYS



(57) Abstract

A custom made liquid crystal display is formed from a pre-manufactured liquid crystal display (10) by removing an excess region (23). The driver card (20) is cut along the line X-X and the excess TABs are disconnected from the conductive layer (18). Optionally, a narrow strip is removed from each of the polarising substrates (15, 16) between the lines (22, 25) to expose their associated glass plates (12, 13). A groove (32 - see Figure 10) is then cut into the exposed surface of each of the glass plates (12, 13) along the line X-X. Each glass plate (12, 13) is then fractured along the base of its groove (32) so that the excess region (23) is detached from the operative region (24). The cut edges of the glass plates (12, 13) are then sealed by applying a bead of ultra-violet curing adhesive. The processes of removing an excess region (23) by cutting the glass plates (12, 13) with a laser or by freezing the liquid crystal between the glass plates (12, 13) and machining through the glass plates (12, 13) are also described.

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IMPROVEMENTS IN OR RELATING TO LIQUID CRYSTAL DISPLAYS

This invention relates to a liquid crystal display, to a method of manufacturing a liquid crystal display, and also to apparatus to aid manufacture of a liquid crystal display.

Generally, displays for reproduction of information have historically been of a cathode ray tube type construction. In an environment where space is limited traditional displays were typically manufactured to be square, or square with rounded corners, in order to make the best use of the limited space available.

Liquid crystal displays are currently considered suitable substitutes for applications previously requiring cathode ray tube technology. The replacement of cathode ray tubes can be either for new applications or for the purpose of upgrading existing technology through retrofit design. When manufactured in large quantities, liquid crystal displays are of modest cost compared with an equivalent cathode ray tube.

However, when liquid crystal displays need to be custom made in relatively low numbers to suit specific requirements, the cost per unit is very high due to expensive tooling and manufacturing charges. Furthermore, manufacturing yield rates are low, high pixel defect levels have to be tolerated and there are substantial delivery delays.

It is an objective of the present invention to facilitate the production of custom made liquid crystal displays.

According to a first aspect of the present invention, a method of manufacturing a liquid crystal display having a liquid crystal sealed between first and second substantially parallel spaced transparent plates which form an operative area of the display, comprises removing an excess region of a pre-manufactured liquid crystal display by cutting the first and second plates to isolate the excess region of the first and second plates and to expose cut edges along the operative areas of the first and second plates.

The terms "cutting" or "cut" as used throughout this document means the action of separating an excess region from an operative region in any way. For example, this may be achieved by grooving and then fracturing a plate, or cutting through a plate with a laser or machine tool.

The inventor has determined that, contrary to the present understanding of the nature of liquid crystal displays, the highly complex electronic and physical structure of such displays can be re-manufactured to provide alternative shaped displays at a much reduced cost per unit, when compared with the cost of a custom made display, and without substantial damage to the display. Furthermore, standard sized displays are readily available devices which may be found in personal computers and other products which use standard sized liquid crystal displays and are manufactured in very high volumes, and hence at low cost.

A liquid crystal display comprises a liquid crystal sealed between first and second parallel spaced transparent plates which form an operative area of the display. In such a display there is a miniscule spacing between the plates. The inventor has discovered that this spacing, when the plates are re-manufactured, exerts a capillary action on the liquid crystal which retains the liquid crystal between the plates without appreciable loss or disruption of

the liquid crystal.

By using a method in accordance with the invention, it is possible to start with an inexpensive standard display and re-fashion it to particular requirements, instead of designing and manufacturing a small number of expensive custom displays or ordering such custom displays from a specialist manufacturer with an added high premium.

The transparent plates are usually formed from glass or another suitable transparent material. The method may include cutting the first and second plates at an oblique angle.

The method may also include removing the excess region of the pre-manufactured liquid crystal display by forming a first groove in the first plate of sufficient depth to isolate the excess region of the first plate, forming a second groove in the second plate of sufficient depth to isolate the excess region of the second plate, the second groove being substantially aligned with the first groove, and fracturing the first plate and second plate along their respective grooves.

The method may include forming the first and second grooves simultaneously and may also include fracturing the first and second plates simultaneously along the first and second grooves.

The method may include fracturing the first plate along the first groove prior to forming the second groove in the second plate and fracturing the second plate along the second groove.

The method, may further include fracturing each grooved plate by placing the other plate on a ridge substantially corresponding with the groove and applying pressure to the excess region.

5 Preferably, the liquid crystal display is placed on an apparatus comprising a fracturing platform having a first light polarising layer to polarise radiation emitted from a radiation source and a second light polarising layer located between a viewer's eye position and the liquid crystal display, and the method may include viewing the propagation of each fracture along its groove as an area against a contrasting background through the second light
10 polarising layer.

Alternatively, the method may include removing the excess region of the pre-manufactured liquid crystal display by cutting the first and second plates using a laser beam thereby isolating the excess region of the first and second plates and exposing the cut edges along
15 the operative areas of the first and second plates. The laser beam may cut entirely through both plates, and this may done from one side of the display. Use of a laser to cut the plates gives good control of the cutting process and is particularly suitable where more complex or rounded configurations are required. It is also envisaged that a laser beam can be used to form grooves in each plate and then pressure applied to the excess area to fracture each
20 plate along the groove. In this manner contamination of the liquid crystal is avoided since the plates may be cleaned after grooves has been formed.

In a further alternative, the method may include removing the excess region of the pre-manufactured liquid crystal display by freezing the liquid crystal between the first and second

plates and machining through the first and second plates thereby isolating the excess region of the first and second plates and exposing the cut edges along the operative areas of the first and second plates. It will be understood that the term freezing includes any reduction in the viscosity of the liquid crystal thereby inhibiting its egress from between the first and second plates.

Although freezing is particularly applicable to this further alternative, it may also be used in other methods in accordance with the invention, for example, when a laser beam is used or the plates are fractured following grooving. Accordingly, the method may include freezing the liquid crystal between the first and second plates prior to cutting the first and second plates.

In the case where conductive layers are adhered to the first and second plates and are electrically connected to driver connections, the method may also include cutting and removing any driver connection associated with the excess region prior to cutting the first and second plates. In the case where a light polariser is adhered to at least one of the plates, the method may include cutting and removing a narrow strip of the light polariser in a region either side of where the cut edge associated with each plate is to be formed.

The method may also include removing air voids within the liquid crystal by applying pressure to at least one of the plates.

Preferably, the method may include sealing the exposed fractured edges to retain the liquid

crystal between the first and second plates. The method may include sealing the exposed cut edges using a laser beam arranged to melt the first and second plates together along the exposed cut edges. This is particularly convenient where a laser beam is used to remove the excess region.

5

Alternatively, the method may include removing an excess region from at least two pre-manufactured liquid crystal displays to leave exposed cut edges, aligning and positioning the exposed cut edges of one of the liquid crystal displays with the corresponding exposed cut edges of an adjacent liquid crystal display, and laminating the liquid crystal displays to form a single display with increased operative area.

10

According to a second aspect of the invention, a liquid crystal display comprises a pre-manufactured liquid crystal display having a liquid crystal sealed between first and second parallelly spaced transparent plates and in which an excess region of the pre-manufactured liquid crystal display has been removed by cutting both of its transparent plates along a common line. In this manner a modified liquid crystal display is provided as a selected portion of a pre-manufactured liquid crystal display.

15

20

The first and second plates may be cut at an oblique angle. The cut edges of the transparent plates may be resealed to retain the liquid crystal. A laser beam may be used to melt the first and second plates together.

A composite liquid crystal display preferably comprises at least two of these modified liquid crystal displays supported with their respective cut edges aligned and abutting. The cut

edges are preferably supported in alignment by a transparent lamina adhered over their first transparent plates. The cut edges may additionally be supported in alignment by a second lamina adhered over their second transparent plates.

5 According to a third aspect of the present invention apparatus, to aid removal of an excess region of a pre-manufactured liquid crystal display having liquid crystal sealed between first and second parallel spaced transparent plates which form an operative area of the display and in which a groove has been formed in one of the plates between the excess region and an operative region of the liquid crystal display, comprises a fracturing platform having a light
10 polarising layer located between transparent first and second supporting surfaces, a radiation source located to emit radiation through the fracturing platform, a raised region arranged on an opposite surface of the fracturing platform to which the light source is located, the raised region being arranged to contact a plate of the liquid crystal display in a region substantially corresponding to the groove in the other plate, and a light polarising layer
15 disposed between a viewer's eye position and a liquid crystal display located on the fracturing platform. In this manner a viewer observes the liquid crystal display as a dark area and when the viewer applies pressure to the excess region any fracture in the grooved plate appears as a light area.

20 The operative area of the liquid crystal display may be clamped to the fracturing platform whilst leaving the excess region freedom of movement. The raised region may be a ridge.

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a diagrammatic cross-section through a conventional prior art liquid crystal display taken along the line 1-1 in Figure 2;

Figure 2 is a plan view of the pre-manufactured liquid crystal display illustrated in Figure 1,
5 but showing the removal of an excess region along its right-hand edge;

Figure 3 is an underplan view of the liquid crystal display illustrated in Figure 2;

Figure 4 is a plan view similar to Figure 2, but showing the removal of an excess region
10 along its right-hand lower corner;

Figure 5 is a plan view of a pre-manufactured liquid crystal display that has been processed
by removing a first excess region along its right-hand edge and a second excess region along
its bottom edge to provide a decreased display area;

15 Figures 6 and 7 are plan views of pre-manufactured liquid crystal displays which have been
processed to remove curved excess regions.

Figure 8 schematically illustrates sealing of cut edges formed in a pre-manufactured liquid
20 crystal display.

Figure 9 illustrates the processing of four pre-manufactured liquid crystal displays, each
similar to that shown in Figure 5, to provide an increased display area, and

Figure 10 is a diagrammatic side elevation of apparatus for aiding removal of an excess area of a pre-manufactured liquid crystal display.

In Figure 1, a typical liquid crystal display 10 comprises liquid crystal 11 trapped between first and second parallel spaced transparent glass plates 12, 13 by an ultra-violet cured adhesive seal 14. Patterned light polarising substrates 15, 16 are respectively adhered to the outer surfaces of the glass plates 12, 13. Very thin conductive layers 17, 18 are respectively coated over the inner surfaces of the glass plates 12, 13 and are used to generate an electric field between corresponding portions of the conductive layers 17, 18 to cause the liquid crystal 11 in the field to rotate and block light from passing. No light can pass the rotated electric crystal within the electric field and a viewer will observe a dark area corresponding to the shape of the electric field. By controlling a plurality of such corresponding portions of the conductive layers 17 and 18, the liquid crystal display 10 can be operated to convey information to the viewer.

In a first embodiment, as will be seen from Figures 1 and 2, the glass plate 13 and its associated conductive layer 18 are larger than the glass plate 12 so that they extend to the left towards a vertical driver card 19, and upwards towards a horizontal driver card 20. A series of ribbon connectors or TABs 21 electrically interconnect the driver cards 19 and 20 with the various portions of the conductive layers 17 and 18 in well-known manner so that the driver cards 19, 20 will determine which portions of the conductive layers 17 and 18 are to be energised.

Figure 3 shows the reverse side of the liquid crystal display 10, the reverse side of the

-10-

vertical and horizontal TAB's 21, driver cards 19 and 20, and the light polarising substrate 16.

5 In Figures 2 and 3 the required width of the final liquid crystal display 10 is indicated by a chained line 22 and is achieved by removing an excess region 23 of the liquid crystal display 10 in the following manner. With reference to Figure 2, one of the vertical driver cards 20 is cut, using any suitable cutting apparatus, along a broken line X-X which is located just outside an operative region 24 of the liquid crystal display 10 that is to be retained. The vertical driver card 20 may be held in a support fixture, not shown, and a fine tooth saw may be used to cut through the vertical driver card 20 along the line X-X. This cut must be beyond any TAB 21 carrying connections to the operative region 24 that are to be retained. Any rough edges can be filed to prevent any track cut from shorting.

15 The portion of the vertical driver card 20 for the excess region 23 is then removed by disconnecting the corresponding TABs 21 using a suitable solvent or heating process. In this manner the removed portion of the vertical driver card 20 and associated TABs 21 are not damaged and can be retained for potential repair use.

20 Optionally, a narrow strip of the light polarising substrate 15, defined by the chained line 22 and a parallelly-spaced chained line 25 on the opposite side of the line X-X, is then removed using suitable cutting apparatus which will not damage the exposed portion of the underlying glass plate 12. For example, a scalpel can be used to cut along the lines 22, 25 so that the narrow strip of the light polarising substrate 15 can be peeled off to expose the glass plate 12 which is then cleaned to remove all traces of the adhesive that was used to bond the strip

of the light polarising substrate 15 to the glass plate 12.

A groove is then formed in the glass plate 12 along the line X-X of sufficient depth to promote the generation of a fracture along the length of the groove when pressure is applied to the excess region 23. This groove can be formed using a scribe, a machine tool set to machine a controlled depth, or a diamond wheel cutter. It may also be possible to use a laser beam operated to form a groove of controlled depth. An apparatus used to aid removal of the excess region 23 is described below with reference to Figure 7.

The liquid crystal display 10 is then reversed to expose its opposite surface as shown in Figure 3. Again, optionally a narrow strip of the polarising substrate 16 is removed from either side of the line X-X to expose a region of the glass plate 13. The process of removing the narrow strip of the substrate 16 is the same as that already described for the removal of the narrow strip of the substrate 15. The exposed portion of the glass plate 13 is then cleaned to remove all traces of the adhesive that was used to bond the strip of the light polarising substrate 16 to the glass plate 13. A groove is then formed in the glass plate 13 along the line X-X of sufficient depth to promote the generation of a fracture along the length of the groove when pressure is applied to the excess region 23. This can again be achieved by using the apparatus that is described below with reference to Figure 7.

It will be understood that either a groove can be formed in glass plate 12 and the glass plate then fractured along that groove prior to forming a corresponding groove in the other glass plate 13 or corresponding grooves can be formed in both glass plates 12, 13 prior to forming fractures in each plate 12, 13.

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By fracturing the glass plates 12 and 13 along the line X-X, the excess region 23 of the liquid crystal display 10 can be removed to expose cut edges of the glass plates 12 and 13. The minuscule spacing between the glass plates 12 and 13 generates a capillary action which acts on the liquid crystal 11 and serves to retain the liquid crystal 11 between the glass plates 12 and 13 so that no appreciable loss or disruption of the liquid crystal 11 occurs.

The process of removing the excess region 22 can create minute voids in the liquid crystal 11, particularly if the cut edges of the transparent plates 12 and 13 do not coincide. Provided the fractures form a clean break, these voids rapidly disappear. Gentle pressure applied to the glass plates 12, 13 can also be used to eliminate some voids and manoeuvre persistent voids to the cut edges and hence out of the liquid crystal 11. Positioning the line X-X along which fractures are formed further away from the operative region 24 reduces the risk of voids or bubbles being formed.

Although the glass plates 12 and 13 could be cut right through along the line X-X, as described below with reference to Figures 6 to 8, there is an increased chance of contaminating the liquid crystal 11 in the operative region with particles of glass and cutting fluid. By only partly cutting through the glass plates 12 and 13, such contaminants can be positively excluded from contact with the liquid crystal, and the glass plates 12 and 13 can be cleaned before being fractured along the line X-X.

If desired, the grooves in the glass plates 12 and 13 can be formed simultaneously by feeding the liquid crystal display between a pair of diamond wheel cutters, thereby also ensuring that the two grooves are parallelly aligned. It will be understood that the grooves formed in glass

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plates 12, 13 and the cutting of the polarising substrates 15, 16 can be performed in a single action.

Irrespective of whether the grooves in the glass plates 12 and 13 are formed separately or at the same time, in this particular embodiment, the cut edges of the glass plates 12 and 13 are sealed by applying a bead of ultra-violet curing liquid crystal display sealant adhesive, and then curing with an ultra-violet light source. This process provides a liquid crystal display 10 having a reduced operative region 24 without the need to commission the production of a custom display by a manufacturer.

Figure 4 illustrates a modification of the process described with reference to Figure 2 to permit the liquid crystal display 10 to be chamfered, that is to have a corner removed. The same reference numerals have been used as in Figures 2 and 4 to denote equivalent features and only the points of difference are now described. The excess region 23 is removed from the operative region 24 along a broken line Y-Y which is inclined to both of the card drivers 19 and 20. The removal process is exactly the same as described with reference to Figure 2 except that there is no need to cut the vertical card driver 20 or to remove any TAB 21.

Figure 5 show how the liquid crystal display 10, produced as described with reference to Figures 1 to 3, can have its operative region 24 reduced still further by removing a horizontal excess region 26 together with the lower portion of the horizontal card driver 19 and associated TAB 21.

Figures 6 and 7 illustrate a second embodiment of the process for removing an excess region

from a pre-manufactured liquid crystal display. The same reference numerals have been used as those in Figures 2 to 5 to denote equivalent features.

The required shape of the final liquid crystal display 10 is indicated by a solid line 22 and is achieved by removing an excess region 23 of the liquid crystal display 10 in the following manner.

With reference to Figure 6, narrow strips of light polarising substrate 15, 16, defined by the solid line 22 and a parallelly-spaced line 25 on the opposite side of broken line C-C, are optionally removed from both sides of the liquid crystal display 10 and the exposed areas cleaned, as previously described. A laser, not shown, is then used to cut through glass plate 12 and glass plate 13 along line C-C. In this manner both glass plates 12, 13 are cut at the same time and the excess region 23 of the liquid crystal display 10 can be removed to expose cut edges of the glass plates 12 and 13.

With reference to Figure 7, a portion of the vertical driver card 20 for the excess region 23 is cut and removed by disconnecting the corresponding TAB's 21, as previously described. Narrow strips of light polarising substrate 15, 16, defined by the solid line 22 and a parallelly-spaced line 25 on the opposite side of broken line S-S, are optionally removed from both sides of the liquid crystal display 10 and the exposed areas cleaned, as previously described. A laser, not shown, is then used to cut through glass plate 12 and glass plate 13 along line S-S simultaneously, as previously described, to expose cut edges of the glass plates 12 and 13.

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It will be understood that although Figures 6 and 7 illustrate curved lines C-C and S-S the process of cutting with a laser can equally be applied to the straight line cuts shown in Figures 2 to 5 or other cut shapes not illustrated. Furthermore, the laser may be used to cut through the driver card and polarising substrate.

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The gap between the plates 12 and 13 is then sealed either by applying a bead of ultra-violet curing sealant adhesive and curing under ultra-violet light conditions, or applying a glass frit or using the laser to weld the plates 12 and 13 together.

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In Figure 8, the glass plates 12 and 13 can be welded to one another by applying a laser beam B in direction D along the cut edge thereby melting the glass plates 12, 13 and forming a seal between the plates 12 and 13. To aid clarity of Figure 8, the light polarising substrates and the conductive layers are not shown and the card drivers and associated TAB's have also been omitted.

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In a third embodiment of the process, not illustrated, the liquid crystal within the liquid crystal display or a part thereof can be frozen or have its viscosity reduced using liquid nitrogen and both plates can then be machined through in one action using, for example, a diamond wheel cutter. In this manner the risk of contamination of the liquid crystal is mitigated and the number of voids introduced into the liquid crystal is reduced.

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Should a liquid crystal display be required with a larger operative region then, as shown in Figure 9, four liquid crystal displays 10 can be prepared as described with reference to Figure 5 and can have their respective operative regions 24 combined by aligning and

abutting their respective cut edges 27 and 28, the four liquid crystal displays 10 then being laminated to form a single display with increased operative area. Such lamination is preferably achieved by adhering transparent plates to the entire front and back surfaces of the four operative regions 24 using an optically clear ultra-violet cured adhesive.

5

The processes described above allow rectangular or square format liquid crystal displays, with reduced or increased operative areas, to be produced quickly and cheaply by reshaping standard commercial rectangular shaped displays which are currently produced in vast quantity at low unit cost and with high quality. Furthermore, since the shaping process is only limited by the positioning of the cards drivers 19, 20 and the excess regions 23, 26 to be deactivated, the process could also be used to produce liquid crystal displays of other shapes, including chamfered corners as taught by Figure 4, curved shapes taught by Figures 6 and 7 and also L-shaped and triangular-shaped formats.

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The above process is effective for removing an excess region of a pre-manufactured liquid crystal display in which the cards drivers are relatively simple in format with only a few passive devices associated with each TAB. Where more complex circuitry exists and the card drivers cannot simply be cut, the process described above can be limited to the technique for cutting the transparent plates, the driver cards then being re-engineered or re-positioned using flexible circuit extensions.

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The groove or final cut edge of each plate in a liquid crystal display may be arranged such that it forms an oblique angle. In this manner a greater surface area is presented for sealing or bonding to a second liquid crystal display arranged to abut the first liquid crystal display

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when forming a display having a greater operative area.

Figure 10 illustrates apparatus 31 to aid removal of an excess area 23 from a pre-manufactured liquid crystal display 10. As described above, the liquid crystal display 10 comprises liquid crystal 11 sealed between first and second parallelly spaced glass plates 12, 13 which also define an operative region 24 that is to be retained. To aid clarity of Figure 10, the light polarising substrates and the conductive layers are not shown, and the card drivers are also omitted. However, these would typically be arranged as described above with reference to Figure 1.

A groove 32 has been formed part-way through the glass plate 12 as described above. The apparatus 31 comprises a fracturing platform 33 having a light polarising layer 34 located between transparent first and second supporting surfaces 35, 36. A radiation source 37, for instance a light source, is arranged to emit radiation through the fracturing platform 33. A raised region, in the form of a ridge 38, is carried by the first supporting surface 25 and is arranged to contact the lower glass plate 13 of the liquid crystal display 10 along a line coinciding with the groove 32 formed in the transparent plate 12.

The apparatus also comprises a light polarising layer 39 disposed between an operator's eye position 40 and the liquid crystal display 10 which is positively located on the fracturing platform 33.

In operation, the operator observes the liquid crystal display 10 as a dark area since radiation from source 37 is polarised by the layer 34, polarised by the liquid crystal 11 and further

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polarised by the layer 39. As the operator applies pressure to the excess region 23, the glass plate 12 will start to fracture along groove 32. As the fracture spreads along the groove 32, it will appear as a light area against the dark area background of the liquid crystal display 10 since the thickness of the liquid crystal 11 is different in the regions where fracture has occurred than in those where it has not, varying the degrees of lighting. Radiation will therefore not be polarised by the liquid crystal 11 along the fracture.

Once a fracture in the glass plate 12 has been achieved, a groove corresponding to groove 32 is formed in the glass plate 13 as has been described above. The liquid crystal display 10 is then turned over and repositioned on the fracturing platform 33 with the glass plate 12 contacting the raised edge 38 along either the line of the groove 32 or the line of the corresponding groove in glass plate 13. Again pressure is applied by the operator to the excess region 23 so as to fracture the glass plate 13 along its corresponding groove. When both glass plates 12 and 13 have been fractured along their respective grooves 32, the excess region 23 is removed and the gap between the fractures sealed as described above.

Alternatively, the liquid crystal display 10 can have grooves 32 on both plates 12, 13 prior to fracturing as described above. As a further alternative, once a plate 12 or plates 12, 13 have had grooves 32 applied, the liquid crystal display is placed on the raised edge 38 such that the excess region 23 contacts the raised edge 38 and a downward pressure is applied to groove or grooves 32 to fracture the plate 12 or plates 12, 13.

CLAIMS

1. A method of manufacturing a liquid crystal display having a liquid crystal sealed between first and second substantially parallel spaced transparent plates which form an operative area of the display, comprising removing an excess region of a pre-manufactured liquid crystal display by cutting the first and second plates to isolate the excess region of the first and second plates and to expose cut edges along the operative areas of the first and second plates.
2. A method, as in Claim 1, including cutting the first and second plates at an oblique angle.
3. A method, as in Claims 1 or 2, including removing the excess region of the pre-manufactured liquid crystal display by forming a first groove in the first plate of sufficient depth to isolate the excess region of the first plate, forming a second groove in the second plate of sufficient depth to isolate the excess region of the second plate, the second groove being substantially aligned with the first groove, and fracturing the first plate and second plate along their respective grooves.
4. A method, as in Claim 3, including forming the first and second grooves simultaneously.
5. A method, as in Claim 3 or 4, including fracturing the first and second plates simultaneously along the first and second grooves.

6. A method, as in Claim 3, including fracturing the first plate along the first groove prior to forming the second groove in the second plate and fracturing the second plate along the second groove.
7. A method, as in Claims 3 to 6, including fracturing each grooved plate by placing the other plate on a ridge substantially corresponding with the groove and applying pressure to the excess region.
8. A method, as in Claim 7 and wherein the liquid crystal display is placed on an apparatus comprising a fracturing platform having a first light polarising layer to polarise radiation emitted from a radiation source and a second light polarising layer located between a viewer's eye position and the liquid crystal display, including viewing the propagation of each fracture along its groove as an area against a contrasting background through the second light polarising layer.
9. A method, as in Claims 1 or 2, including removing the excess region of the pre-manufactured liquid crystal display by cutting the first and second plates using a laser beam thereby isolating the excess region of the first and second plates and exposing the cut edges along the operative areas of the first and second plates.
10. A method, as in any preceding claim, including freezing the liquid crystal between the first and second plates prior to cutting the first and second plates.

11. A method, as in Claim 1 or 2, including removing the excess region of the pre-manufactured liquid crystal display by freezing the liquid crystal between the first and second plates and machining through the first and second plates thereby isolating the excess region of the first and second plates and exposing the cut edges along the operative areas of the first and second plates.
12. A method, as in any preceding claim and wherein conductive layers are adhered to the first and second plates and are electrically connected to driver connections, including cutting and removing any driver connection associated with the excess region prior to cutting the first and second plates.
13. A method, as in any preceding claim and wherein a light polariser is adhered to at least one of the plates, including cutting and removing a narrow strip of each light polariser in a region either side of where the cut edges associated with each plate is to be formed.
14. A method, as in any preceding claim, including removing air voids within the liquid crystal display by applying pressure to at least one of the plates.
15. A method, as in any preceding claim, including sealing the exposed cut edges to retain the liquid crystal between the first and second plates.
16. A method, as in Claim 15, including sealing the exposed cut edges using a laser beam arranged to melt the first and second plates together along the exposed cut edges.

17. A method, as in Claims 1 to 14, including removing an excess region from at least two pre-manufactured liquid crystal displays to leave exposed cut edges, aligning and positioning the exposed cut edges of one of the liquid crystal displays with the corresponding exposed cut edges of an adjacent liquid crystal display, and laminating the liquid crystal displays to form a single display with increased operative area.
18. A method substantially as illustrated in and/or described with reference to any of the accompanying drawings.
19. A liquid crystal display manufactured by the method of any preceding claim.
20. A liquid crystal display comprising a pre-manufactured liquid crystal display having a liquid crystal sealed between first and second parallel spaced transparent plates and in which an excess region of the pre-manufactured liquid crystal display has been removed by cutting both of its transparent plates along a common line.
21. A liquid crystal display, as in Claim 20, wherein the first and second plates are cut at an oblique angle.
22. A liquid crystal display, as in Claims 20 or 21, wherein the cut edges of the transparent plates have been resealed to retain the liquid crystal.
23. A liquid crystal display, as in Claim 22, wherein a laser beam has been used to melt

the first and second plates together.

24. A composite liquid crystal display comprising at least two liquid crystal displays in accordance with Claims 20 or 21 supported with their respective cut edges aligned and abutting.
25. A composite liquid crystal display, as in Claim 24, in which the cut edges are supported in alignment by a transparent lamina adhered over their first transparent plates.
26. A composite liquid crystal display, as in Claim 25, in which the cut edges are additionally supported in alignment by a second lamina adhered over their second transparent plates.
27. A liquid crystal display substantially as illustrated in and/or described with reference to any of Figures 2 to 8 of the accompanying drawings.
28. A composite liquid crystal display substantially as illustrated in and/or described with reference to Figure 9 of the accompanying drawings
29. Apparatus, to aid removal of an excess region of a pre-manufactured liquid crystal display having liquid crystal sealed between first and second parallel spaced transparent plates which form an operative area of the display and in which a groove has been formed in one of the plates between the excess region and an operative

region of the liquid crystal display, comprising

a fracturing platform having a light polarising layer located between transparent first and second supporting surfaces,

a radiation source located to emit radiation through the fracturing platform,

a raised region arranged on an opposite surface of the fracturing platform to which the light source is located, the raised region being arranged to contact a plate of the liquid crystal display in a region substantially corresponding to the groove in the other plate, and

a light polarising layer disposed between a viewer's eye position and a liquid crystal display located on the fracturing platform.

30. Apparatus, as in Claim 29, wherein the operative area of the liquid crystal display is clamped to the fracturing platform whilst leaving the excess region freedom to move.
31. Apparatus, as in Claims 29 or 30, wherein the raised region is a ridge.
32. Apparatus, substantially as illustrated in and/or described with reference to Figure 10 of the accompanying drawings.

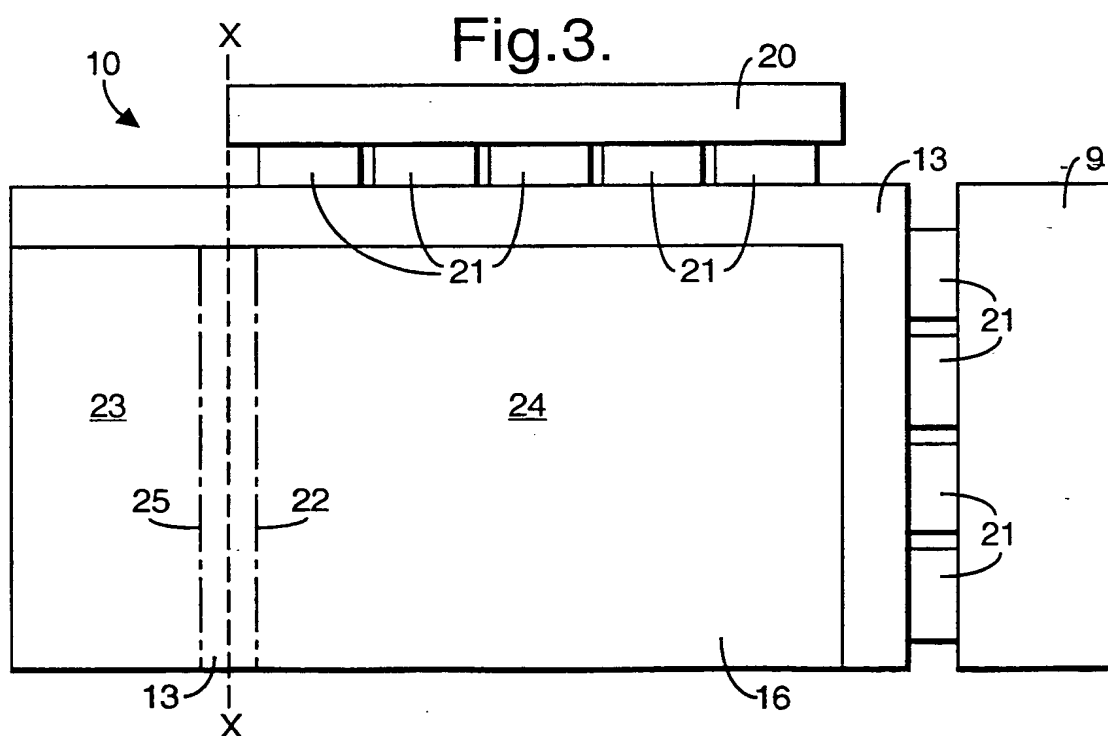
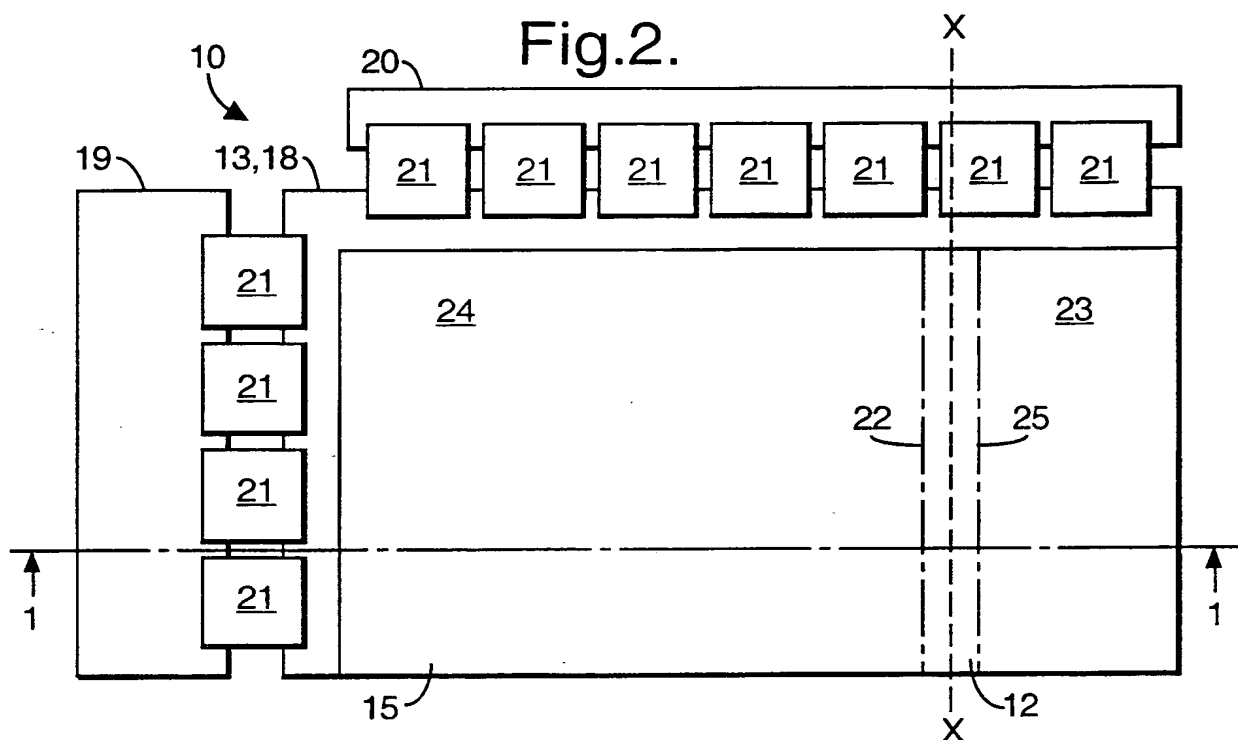
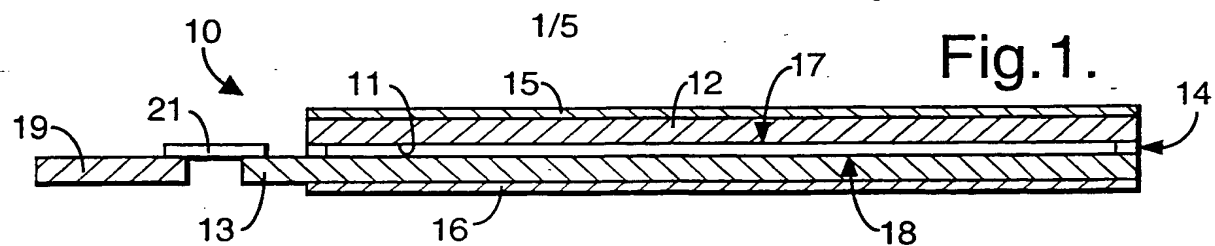


Fig.4.

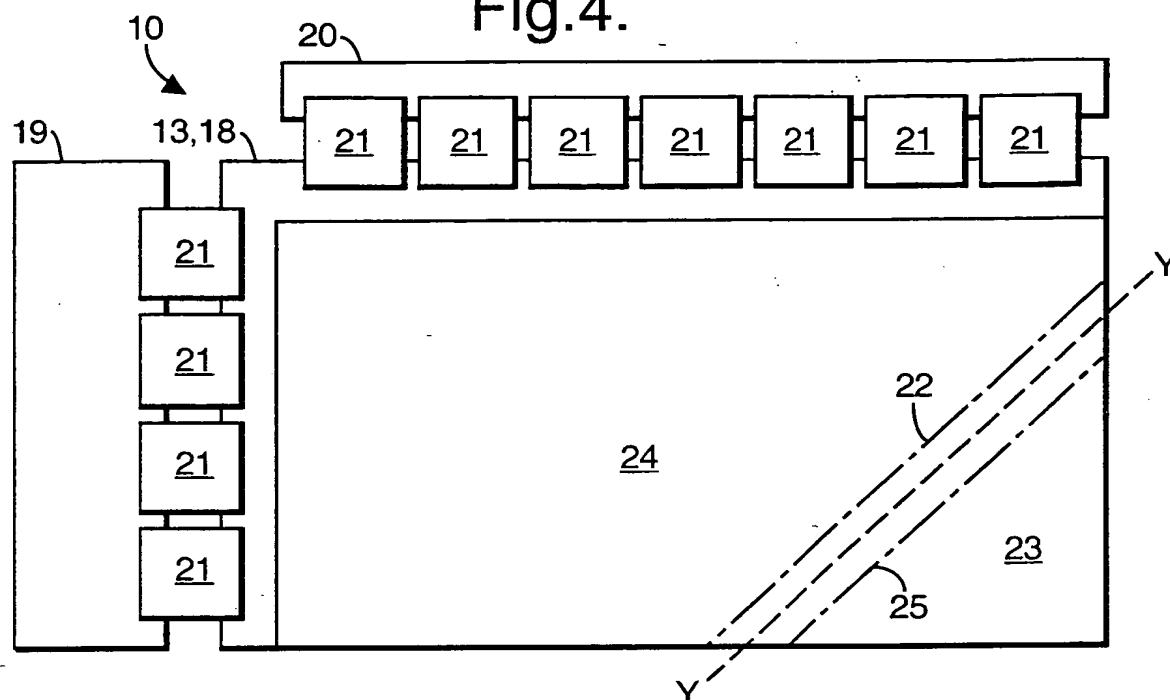


Fig.5.

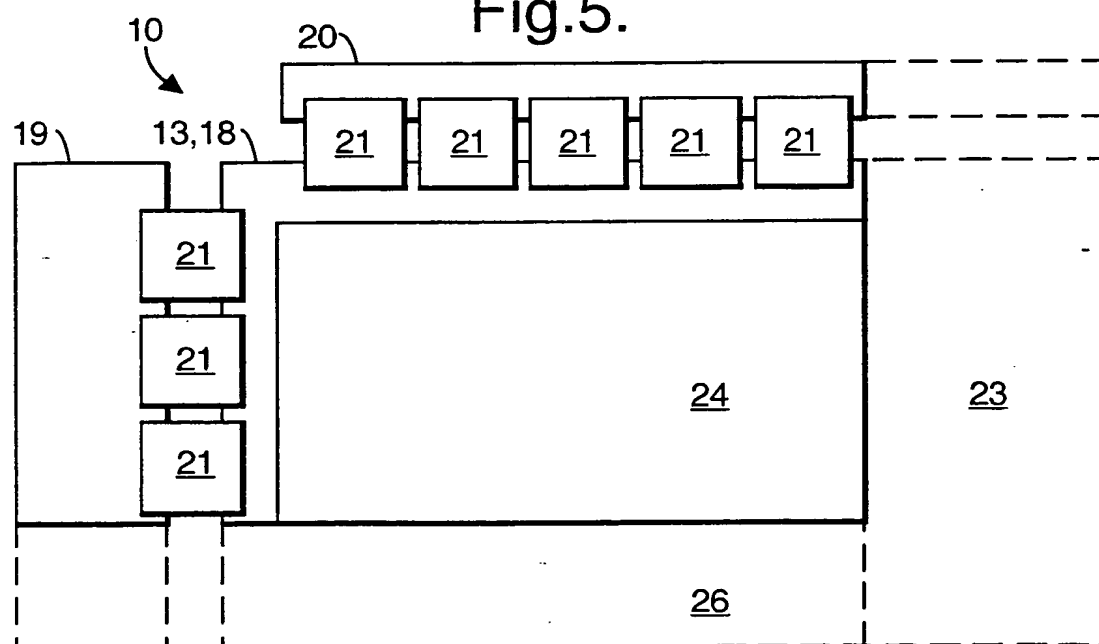


Fig.6.

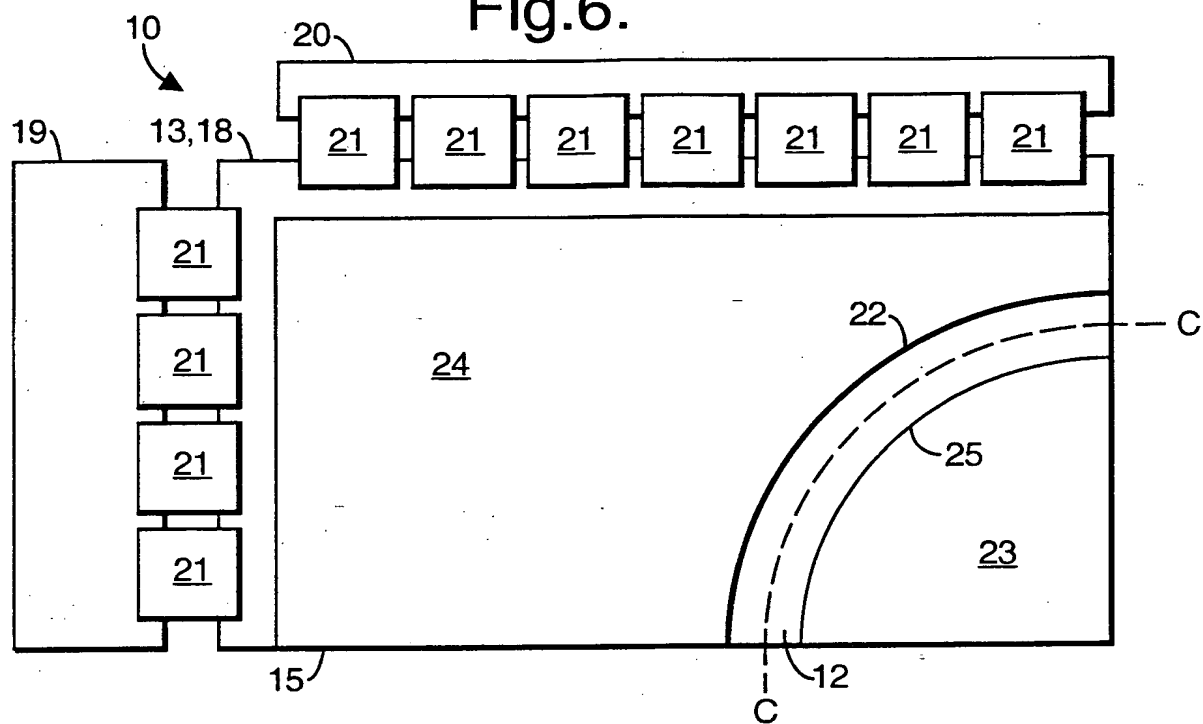


Fig.7.

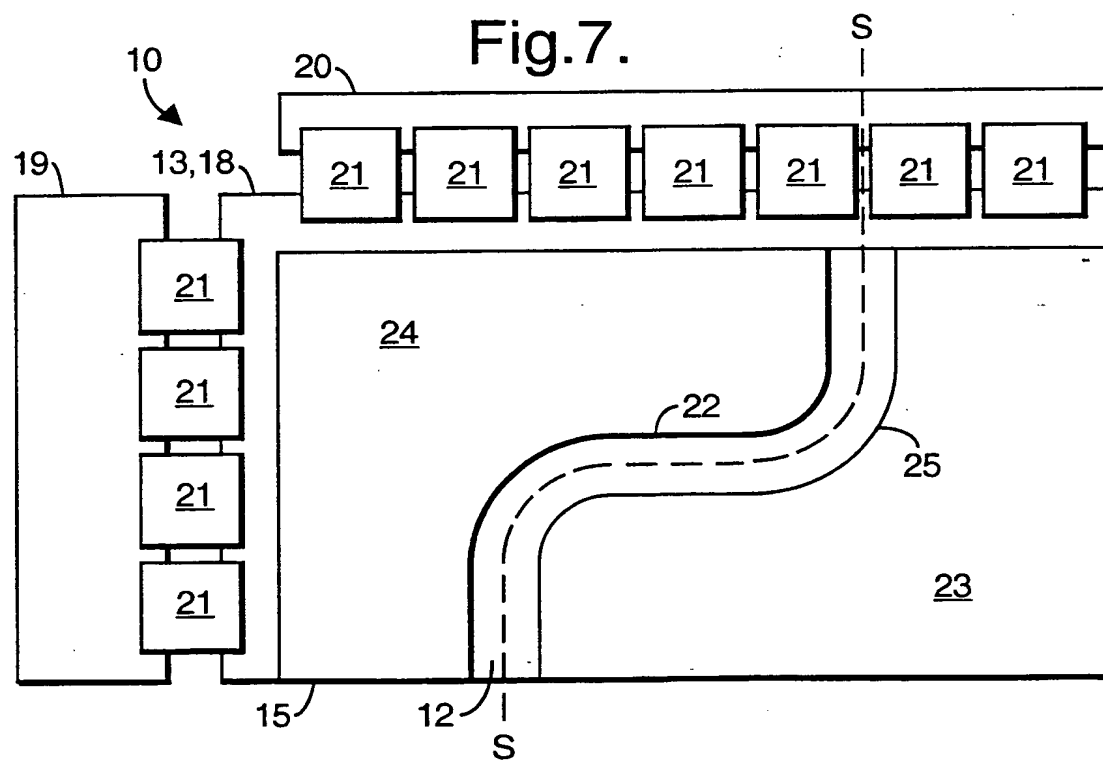


Fig.8.

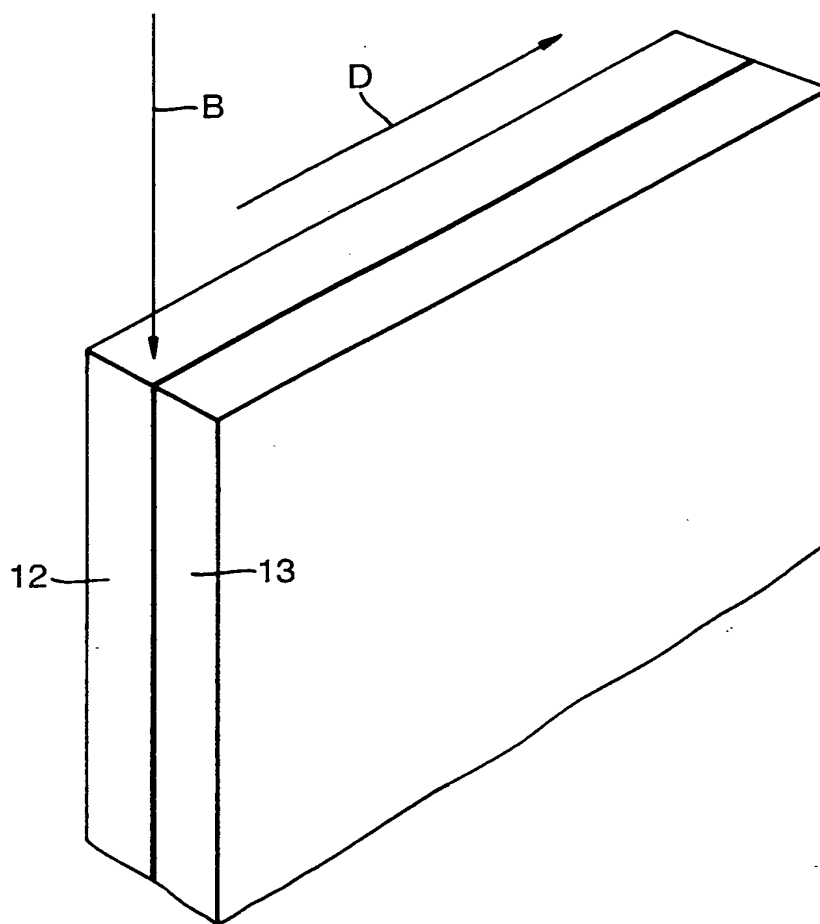


Fig.9.

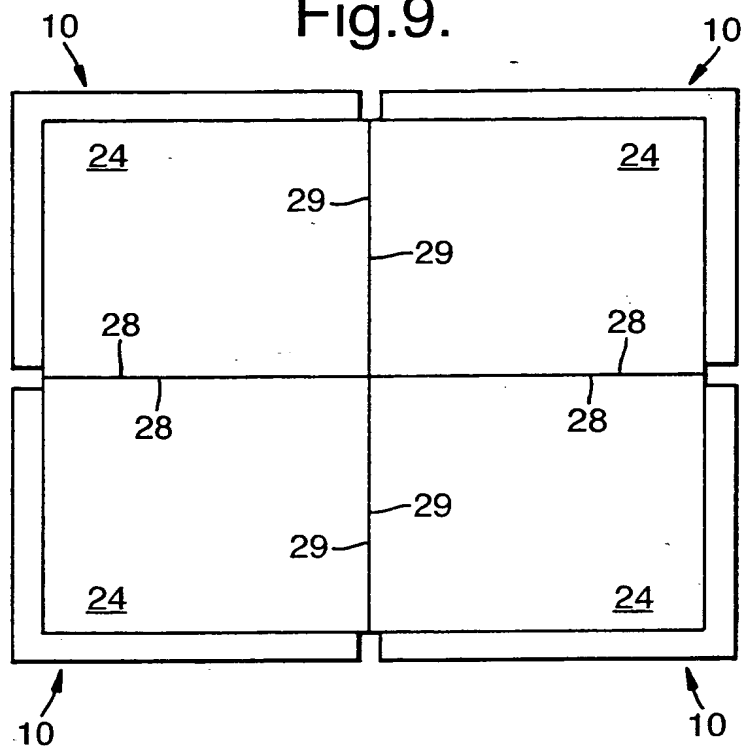
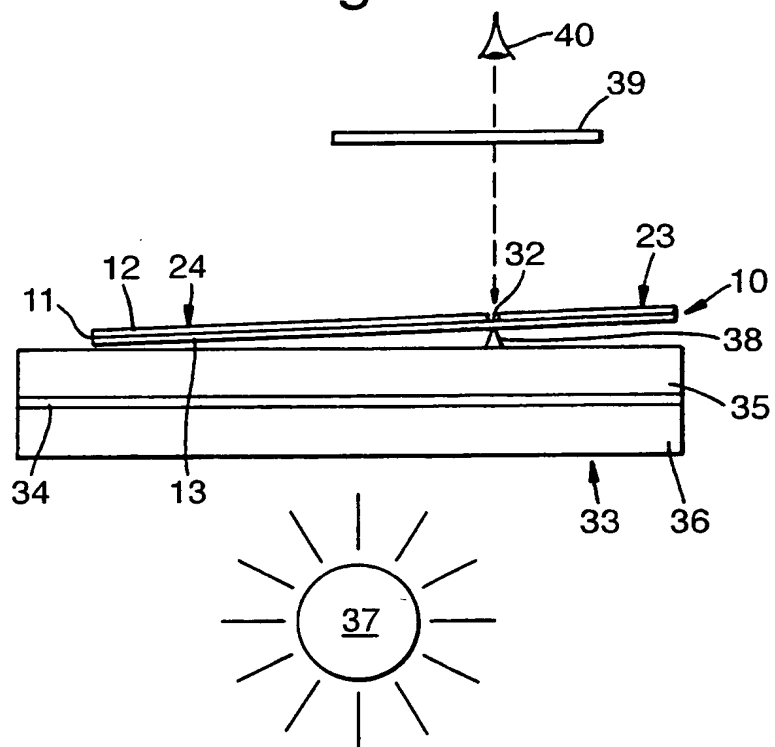


Fig.10.



INTERNATIONAL SEARCH REPORT

onal Application No

PCT/GB 98/02586

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G02F1/1333 C03B33/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	US 5 808 719 A (SHARP) 15 September 1998	1-7, 9, 17, 19-21, 24-26
X	see column 5, line 37 - column 13, line 12; figures 13, 20 -& JP 08 076074 A (SHARP) 22 March 1996	1-7, 9, 17, 19-21, 24-26
X	see figures 13, 20 PATENT ABSTRACTS OF JAPAN vol. 96, no. 10 & JP. 08 146444 A (NIPPONDENSO), 7 June 1996 see figures A-D	1, 14

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

24 November 1998

Date of mailing of the international search report

03/12/1998

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INTERNATIONAL SEARCH REPORT

Initial Application No
PCT/GB 98/02586

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	JP 08 122769 A (SHARP) 17 May 1996 see figure 3B	1,20
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